

Millimeter waves and biological effects

It has been known for well over a hundred years that millimeter waves can be biologically active (Bose 1906). Though beneficial effects can result from short-term millimeter wave treatments (MMWT) (Table 1), side effects can also arise. The effects of long-term chronic exposures have yet to be assessed.

Table 1: Biological effects reported from mm wave exposures				
Power Density [$\mu\text{W}/\text{cm}^2$]	Frequency range	Exposure type	Effects noted	Author
0.000,000,000,1 to 0.0001	30-60 GHz	5-15 minutes exposure	Stimulated growth of pine seed microflora.	Ratushnyak et al. (2008)
0.000,000,01	54-76 GHz	5 minutes per day for 5 days on mice previously exposed to ionizing radiation	Normalizing effect on growth of damaged cells.	Bundyuk et al. (1994)
0.07	53.37-78.33 GHz	1-hour exposure every 2 days. 5 treatments given to human breast cancer cells in culture.	Cell number approximately 60% less in irradiated group of cells than in sham-exposed control.	Beneduci et al. (2005)
0.1	41.303 GHz	10-minute irradiation.	Maximum effect on <i>E. coli</i> cells' genome conformational state.	Alipov et al. (1993)
≥ 0.3	60 GHz	1-minute exposure [3 current cycles - 5 second exposures every 20 seconds].	Changes in firing rate of neurons.	Siegel & Pikov (2010)
1 – 3	54-78 GHz	4-6 treatment sessions, each of 10-20 minutes duration.	Complete relief of headaches in 122 out of 177 patients with pre-stroke forms of cerebrovascular pathology ¹	Kuz'menko (1998)
10	42.2GHz	Mice received 30-minute whole body exposure daily for 15 days.	Tumor growth inhibited by 33.5% compared to controls.	Kalantaryan et al. (2016)

As an example of the kinds of environmental exposures humans may expect to receive, mention is made of the FCC's radiated emission limits for automobile radar systems (Table 2) (FCC 2012, 2015).

Table 2: Radiated emission limits for automobile radar systems at 3 meters² from source		
Frequency bands	Average power density	Peak power density
76-81 GHz	88 $\mu\text{W}/\text{cm}^2$	279 $\mu\text{W}/\text{cm}^2$

Sources: FCC (2012), FCC (2015).

As would be expected, RF exposure levels nearer vehicles could be far higher.

¹ 65% of patients receiving this treatment remained in remission for around 1 year, versus 20% in control group

² Permitted exposures are far greater next the location of the devices on automobiles. Cyclists and pedestrians are likely to be exposed at [far](#) higher intensities when they are within 3 meters of the equipment, as [will wildlife and the nearby environment](#).

Side effects from short-term MMWT exposure

Mild side effects have been reported as a result of short-term mm wave exposures.

Paresthesias

In a number of patients minor short-term paresthesias [a sensation of burning, numbness, prickling or tingling that most often occurs in the body's extremities] has been reported as a result of exposure, as have feelings of fatigue and sleepiness (Usichenko et al. 2006, Radzievsky et al. 1999).

It is suggested by the author that such side effects may be likely to arise in members of the general population as a result of chronic long-term environmental exposures.

Altered neuronal activity

Tests have indicated that neuronal activity in the brain can be affected by very low intensity short-term exposures to mm waves (Siegel & Pikov 2010).

Hypoalgesia

It is proposed that since the body's opioid system³ is indicated as being involved in the electromagnetic inducement of hypoalgesia [a decreased sensitivity to painful stimuli] as a result of the activation of the peripheral nervous system by mm waves (Radzievsky et al. 2008), there is the possibility that various environmental exposures to mm waves will act in a similar fashion.

Though reduced perceived pain intensity is often beneficial, particularly within official medical treatment, it can in some circumstances prove detrimental. Moreover, as chronic exposure to opioids can cause hypersensitivity to pain (College of Physicians and Surgeons of British Columbia 2015), there appears the possibility that chronic exposure to mm waves may create such effects in susceptible individuals creating an unnecessary health burden.

Cancer

Research also suggests that other unwanted side effects may arise. It has already been shown that short-term mm wave exposures, at levels that birds in the wild might be experience if in close proximity to high-intensity emitters in real life, may accelerate tumor growth.

In research by Bellossi et al. (2000), DBA/2 mice were irradiated with 60 GHz waves for 30 minutes a day, for 5 consecutive days a week at 500 $\mu\text{W}/\text{cm}^2$. While mice with lymphocytic leukemia cells showed increased survival (for 2 series out of 4), mice with Lewis tumor cells exhibited accelerated tumor growth. The exposure level was half that permitted by both ICNIRP (1998) and the FCC (1996) in basic restrictions for members of the general public.

Radio waves are already classified as 'Group 2B Possible Carcinogens' (WHO/IARC 2011), with some experts now calling for them to be upgraded to Group 2A 'Probably carcinogenic to humans', or even to Group 1 'Carcinogenic to humans' (Hardell & Carlberg 2015, 2013). The recent NTP (2016) findings could be particularly instrumental in causing such an upgrade.

Conclusion

It appears from the above that great caution is warranted with regard to the proposed widespread rollout of mm wave frequencies.

It is already known that mm waves can be biologically active. Proper assessment of the potential health and environmental consequences of their widespread use is urgently required. An unchecked proliferation of 5G technologies could create catastrophic results. A far more sophisticated approach is required in this 'Bioelectromagnetic Age'.

Widespread proliferation of biologically active electromagnetic fields, including mm wave frequencies, could lead to unprecedented public health and environmental disasters. Pre-market safety testing is urgently required to help prevent expensive and unnecessary risks being taken and help optimize investment in order to create the better future we need.

³ Opioids act on the body's opioid receptors to enable morphine-like effects.

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